ABSTRACT

EMPACT Title – Drought Alert Network

Project Team
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Project Cost Total funding requested: $399,992.16 Actual program cost: $445,767.00*
**includes most institutional cost share contributions of key partners*

Project Summary

Droughts are fast becoming a part of the natural landscape in the US, yet governments and communities seem unprepared to manage these events. In 1999, record low rainfall led to widespread concern regarding the integrity and availability of the water supply in Rhode Island. It became clear that decision-makers were hampered in their ability to properly assess water resources due to a lack of, or restricted access to, time relevant water supply/use information. In several instances, state, local and regional experts were not in agreement regarding environmental conditions and confused the public with mixed messages. At times of peak demand, crisis management prevailed and in many cases, aggressive water restrictions had to be enforced. Eventually, the entire state of Rhode Island was declared a federal disaster area.

In almost every crisis, there is opportunity. Rather than react, we can learn from drought and take preemptive steps to ward off its effects. Traditionally, dry periods have spurred expansion of *water supply infrastructure*—new water supply wells typically paid for with emergency funds distributed on a first-come, first-serve basis. Such wells are often installed on private lands with little consideration of regional hydrology, and thus have limited application. The Drought Alert Network (DAN) proposal offers a less costly and more effective response to drought. This innovative project will spur expansion of *water information infrastructure*—a much needed advanced communication system of integrated databases, maps and web pages that will vastly enable improved decision-making, both locally and statewide. EMPACT will be used to pilot a water supply monitoring system that provides timely recognition of drought coupled with a communications strategy to enable a quick, cooperative and effective managerial response.

The proposed application is for a fully automated, real-time, web-enabled data system featuring "no hands delivery" of information. By "no hands", the means by which a water user is alerted to potential water shortages is managed by computers communicating with other computers. While some federal and state agencies have rolled out automated monitoring and public notification systems with voice output or data display using tables, graphs or maps served up on a web page, none appear to be using scripts that broadcast, fax or email messages and maps by joining a contact database to a web-enabled geographic information system (GIS). DAN will feature Arc Internet Mapping Software (ArcIMS) from ESRI enhanced with a multi media messaging

component. In addition to traditional methods of communication, the vision entails directing conservation alerts to major water users and/or municipal water suppliers, and automatic notification to the public via major media outlets. The notification component of DAN may be enhanced by adding a commercially available wireless instant messaging application.

Separate, yet concurrent with this effort, a drought management planning task force has developed drought severity indices for Rhode Island that will be used to signal or "trigger" drought, whether on a statewide or regional basis, or at a local watershed level. It is critical to know what criteria should be applied in any given situation and how to correlate trend data with current conditions. Monitoring parameters will include reservoir and groundwater well levels, stream flow, precipitation, and other locally occurring variables such as crop moisture and fire danger to the highest degree possible. Municipal water suppliers also use indicators based on local conditions in their jurisdictions. These measures encompass variables beyond availability of water itself. For instance, water facilities storage and treatment capacity may be inadequate at certain times of year depending on demand—a scenario which by itself might be enough to trigger an automatic drought alert. At other times, multiple indicators must be monitored and interpreted by experts—whether on a regional or local level—before issuing an alert. In other words, there would be times when the system would not be totally seamless, i.e., hands-free. A drought alert would consist of a menu of voluntary conservation measures imposed at various stages of drought.

DAN will be researched and developed by an interdisciplinary team of experts led by EPA – New England and partnerships with PWSB, NK, BCWA, WRB, URI and ESRI. In the name of innovation and time-relevancy, the Project Team will: 1) work with municipal water suppliers in a pilot area to automate and/or increase the frequency of data collection and transmission wherever feasible; 2) work to expand the public's capacity to access and interpret local and regional water supply/use data; and 3) involve a broad array of stakeholders. The primary objective is to implement proactive and nonregulatory measures that reinforce conservation and help avert water supply crises. The state of Rhode Island has no rules or legislated mandates to reduce water use. DAN will provide insight into environmental conditions, significantly enhancing decision support and technological capacity at the community level. This project will reach end users everywhere—from recreational water lovers to commercial and industrial users, from the scientific community to government and emergency response. DAN is a unique, relevant and prudent alternative to the current, reactive and unnecessary practice of expanding water infrastructure to combat drought. By organizing data providers, and web-enabling previously inaccessible water supply information, stakeholders' "need to know" is best served.

***Note**: This grant application was first submitted as an EPA Region 1 led project in 2000 and rated, **Good**. Reportedly, it was the only grant addressing drought. Among the remarks, "The proposal is extremely well written and responsive to the RFA…The project is innovative, creative and proactive in its approach." The 2000 proposal did not explicitly describe EPA's involvement. However, a project management and information plan has already been fully developed for the 2001 proposal.*

DROUGHT ALERT NETWORK: PROJECT DESCRIPTION

Assessing Drought Impact and Response on Constituents

In general, the Drought Alert Network (DAN) will be designed to perform rapid assessment of drought and then steer response action based on drought severity indices that are specific to various users. Conservation measures that can most effectively mitigate drought impacts require actions by individuals. Shallow private or community wells may go dry or begin drawing in salt water (in coastal communities) as groundwater levels drop, presenting health and fire safety hazards. An essential component of the DAN would be to increase public awareness regarding intensity of drought, which water suppliers have instituted conservation measures, where to find drought information and other recommendations for conservation. Twenty-nine major municipal and private suppliers provide water to approximately 87% of Rhode Island (RI), with the remainder provided by private and smaller community wells. In lieu of a statewide water allocation plan, water suppliers now independently impose restrictions based on various criteria and system limitations. The DAN will assist water suppliers in optimizing the capacity and operation of water facilities and provide a sound basis for planning capital improvements to serve expected growth.

Agriculture is often the first sector to be affected when drinking water supplies for animals and irrigation dry up. The DAN will afford farmers a management tool to implement proactive, best management practices to mitigate drought, rather than make reactive water allocation decisions. Additionally, when ponds and streams that are relied upon for fire fighting evaporate, response times increase as fire fighters seek alternate sources. Depending on criteria that are selected and/or integrated in the DAN, it would be possible to alert the emergency response community regarding where fire risks are greatest. During drought the safety of swimming ponds may be affected when water levels are low; bacterial contamination would become an issue if there were not enough dilution capacity in swimming areas. The DAN could display geographic information regarding low pond levels and stream flow for recreational uses. Furthermore, economic impacts on industry can include loss of production due to use restrictions, increased costs for alternate water supplies (e.g., for cooling) and job loss if shifts must be eliminated. The DAN will be a valuable planning tool when assessing areas in terms of current or future water supply, as well as to provide online information on commercial and industrial water conservation practices. The DAN will provide a central repository for data from a wide range of academic sources, which would be accessible for long-term trends analyses, modeling and other water related studies.

OBJECTIVES OF THE DROUGHT ALERT NETWORK

- To sustain and protect water resources by focusing on demand management based on actual "real time" water events.
- To provide a tangible project to organize various stakeholders around with an opportunity to "get connected"— through partnerships, and by way of intelligent computer systems.
- To coordinate statewide water resources information among federal and local partners, watershed groups, universities and water users.
- To benefit multiple constituents (i.e., water suppliers, municipal planners, citizens groups, etc…) that are desperately in need of, or delayed in rolling out information systems and web-based technology for data synthesis, analyses, visualization and notification.
- To improve upon the delivery of local water information in a language or visual medium that

the average person can understand.
- To increase the public's awareness regarding watershed-based conservation by illustrating drought effects in a timely manner.
- To bridge the gap between land use planning and water resources management.

APPROACH

This proposal seeks to build a partnership employing a joint approach to management information systems centered on drought. The DAN is envisioned to be a relational database management system (RDBMS) containing physical and spatial criteria. It will be accessible online to multiple users and the public. The choice of spatial data, drought indices, and appropriate responses that serve as the foundation of the DAN will be based on the pending RI Drought Management Plan modeled after one in MA. What distinguishes this effort from any other in the country will be the inclusion of a web-based spatial analysis and data dissemination component. The ArcIMS application will increase the accuracy of information regarding water supply and improve predictability of drought so that all water users can make informed decisions.

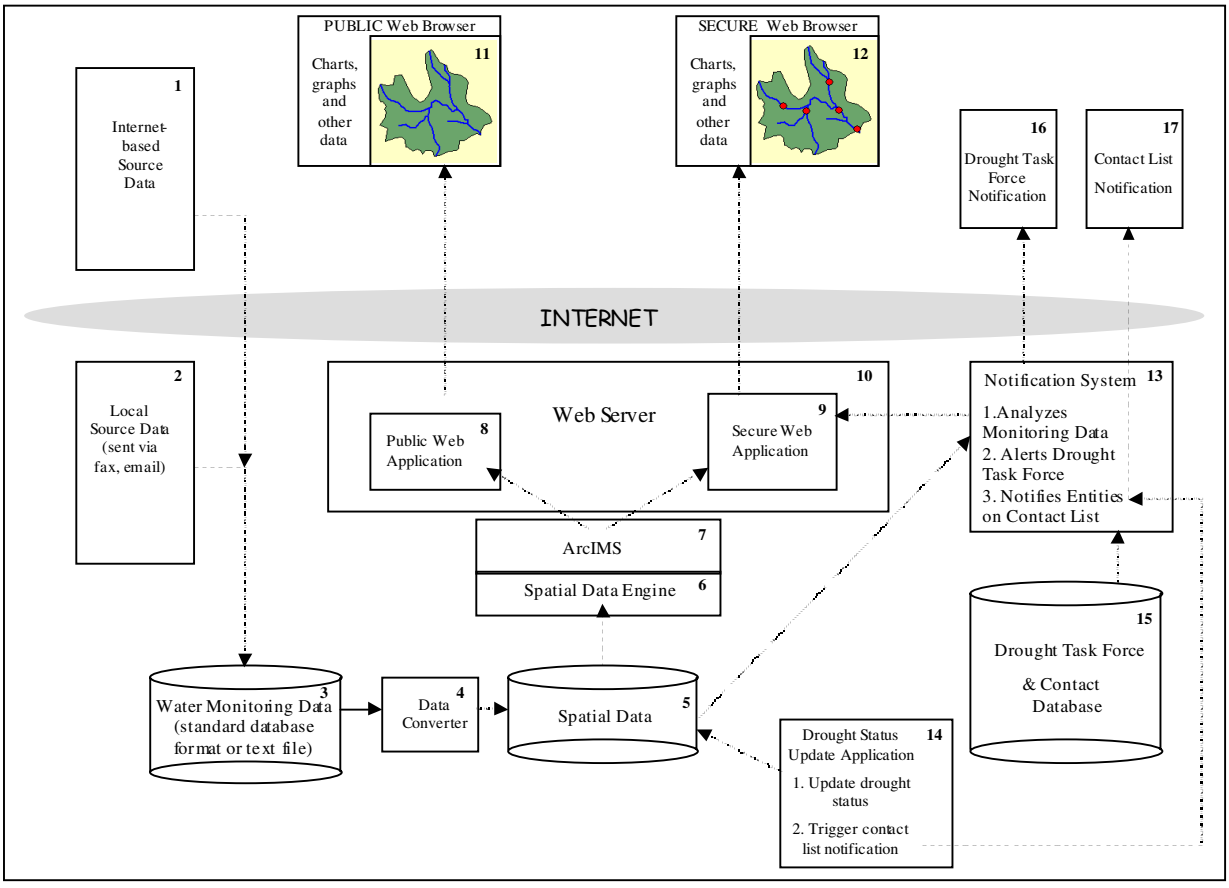
The EMPACT work plan proposes to implement a pilot project using surface and ground water data provided by a select group of water suppliers, supplemented by static and real time data from existing US Geological Survey monitoring stations in the metro area of Warwick-Providence-Fall River, MA RI. The intent of the program is to work with a variety of suppliers from the most sophisticated districts in terms of size, availability/use of automated water monitoring equipment and information systems, to the very least. These systems include PWSB, BCWA, and NK Water Department. A way to keep suppliers informed is through direct communication with partners as well as through the RI Water Works Association (RIWWA). The Project Team has learned that more local water suppliers are moving toward the use of automated systems such as SCADA (Supervisory Control and Data Acquisition), GIS and the Internet. SCADA is a centrally controlled supervisory system that monitors operations, water quality and quantity throughout a water supply network. A long term goal is to integrate real-time information systems among willing partners since the ability to both report and receive high quality data on drought conditions is essential to appropriate, effective and timely management of the resource. With technology transfer, there is a realistic opportunity to obtain the type and amount of data needed to implement and sustain the DAN across the state.

Environmental Parameters: Surface Water, Ground Water and Atmospheric Data

PWSB is the only water supplier in RI that provides data online. They provide surface water data for six reservoirs that form the Scituate Reservoir Complex with a combined capacity of 41.3 billion gallons. It is the largest water district in the state. The data is collected using automated monitoring equipment and includes continuous, daily water level and volume measurements, daily water withdrawals, cumulative yield and historical averages. PWSB manages its facility using a SCADA system, which features a combination of monitoring equipment and telemetry that can be either fully automated or manually operated. For this project data inputs will be accessed from the PWSB web page and used to test out the ArcIMS application. BCWA is a smaller water district serving three communities. BCWA will provide data from four surface water reservoirs, three of which are located in MA and the other in RI. Reservoir level measurements are gathered manually on a daily basis during June through September. Daily readings documented on field worksheets will be transmitted to the Project Team by facsimile. NK serves a moderately sized, public water district. Geographically, the underground water

source spans three different aquifers. NK operates with a network of ten groundwater wells. The district is currently designing a SCADA system and plans to purchase monitoring equipment to allow for continuous groundwater readings. Measurable parameters will include well drawdown, recharge rate, pumping rates, volume production, etc. NK plans to provide real time data over the Internet in the fall of 2001. USGS will provide real time surface water data from geographically referenced, automated stream gauges within or around the metro area. Remotely sensed data and manually acquired surface water data will be accessible from the USGS web page. USGS data will be used in tandem with locally acquired water data and for early testing of the ArcIMS application. The USGS will similarly provide real time, ground water measurements from geographically referenced observation wells within or around the metro area. If feasible, the Project Team will make use of precipitation, soil moisture and other National Oceanic and Atmospheric Administration (NOAA) and National Weather Service (NWS) data from geographically referenced climate stations in and around the metro area. More data will result in better drought predictions.

DAN System Overview Diagram



Drought Alert Network Data Flow Process *(Please refer to DAN System Diagram above)*
Because no single automated drought network exists, the Project Team will design the ArcIMS application with EPA's data systems in mind, particularly the Central Data Exchange portal. This project will provide for data management on two levels: 1) sharing the existing real-time data collection, processing and delivery capabilities of USGS, NOAA/NWS systems currently in use in the metro area and, 2) developing a complementary management information system, i.e., DAN, to aggregate and display data on a more localized geographic scale than federal partners

can otherwise provide. The first phase would involve design, development and population of a shared, spatially referenced database using data from a workable, yet representative, number of water suppliers. This phase will also include development of the messaging and communication "alert" components of the information system, as well as EMPACT web page design. The foundation of these components will be ESRI's ArcIMS (Internet Mapping Software) and "Notification System". The Notification System would draw on data from a spatially referenced database, conduct analyses on monitoring data, and send the appropriate "alerts" to individuals or organizations stored in a contact database.

ESRI and URI will play a role in executing various facets of the DAN, from research, development and management of data systems to web page design, education and outreach. The web system will tentatively consist of the following modules: 1) Project Overview featuring EMPACT project goals, participants and funding; 2) Current water availability featuring clickable maps of participating surface and ground water suppliers with the regions they serve, graphs, maps or other visualization devices to indicate current water levels at test-monitored sites, past water levels (week, month, last 12 months), and averages; 3) Water Supply Data Archives featuring historic records in digital format. The DAN would be tested using PWSB data. It is hoped that once the prototype is properly evaluated—and demonstrated—the DAN could be rolled out to the remainder of the pilot area. Eventually, as water suppliers implement SCADA and web enable real time data, the DAN can by systematically expanded statewide.

The primary components of the DAN architecture would consist of certain interoperable technologies in combination. Data standardization and integration are supported. The functionality of a totally seamless, "no hands" information delivery system can be illustrated in terms of the business process being automated—in this case, the drought alert. The DAN will be designed to recognize when certain water data is required from information holding entities and will *pull* it [from other data systems into a central monitoring station] without being instructed by a computer operator. Other times, the DAN will "know" that a receiving entity will need certain information for processing [such as a remote database] and will *push* it into that system, again, without being directed to do so by a person. Receiving entities will want to be informed when certain events happen, when conditions that would trigger a drought alert are present. These entities could "subscribe" to the DAN for notification. Under this scenario, information holding entities are varied (federal partners, water suppliers) but the central monitoring entities (WRB-URI) would be the primary holding entities from which drought alerts or education messages would originate. To send direct messages to major users and the media [or directly to their information systems], a contact database joined to a GIS is required. The data would be called up automatically at certain intervals and packaged in a particular format such as a table, map, letter, press release or voice message. A menu of drought alerts would contain different messages with corresponding conservation measures depending on the user category of the receiving entity.

The Drought Task Force has identified five levels of drought: Normal, Advisory, Watch, Warning, and Emergency. Color maps would display geographical areas affected by drought, ideally blending information from numerous sources and selected drought indices into a graphical depiction of existing conditions. As the system becomes more refined in terms of the definitions and stages of drought, it would distinguish whether dry conditions were primarily affecting agriculture, public safety, drinking water supply, etc. A determination of which level has been reached is based on seven indices: Palmer Drought Severity Index (PDI): an index that reflects soil moisture and weather conditions available from the National Weather Service or

National Climate Data Center, the Crop Moisture Index (CMI): an index that reflects short-term soil moisture conditions as used for agriculture available from the National Climate Data Center, Fire Danger, Precipitation, Ground-water levels, Stream flow levels, and Index Reservoir levels. Drought level will be determined based on the number of indices which have reached a given drought level. Predetermined drought response actions would then take effect. The media would receive regular updates on drought status, including maps and lists where water restrictions are in place. The drought alerts could be directly transmitted to subscribers by email, fax or the Internet. Alternatively, the public could rely on reports from various media outlets including the EMPACT web sites. The public could also call a prerecorded hotline for information. (i.e., A water supplier might receive a drought alert imposing [voluntary] lawn-watering restrictions for homeowners in a district triggered by a sustained, low reservoir elevation. Major irrigators might receive an alert suggesting reduction of water withdrawals at times of peak demand triggered by a sustained, low flow reading from a stream gauge. Industry might receive an alert suggesting nonessential water use be curtailed and wastewater discharges be reduced. Members of the drought task force would receive an alert prompting a meeting to interpret data suggestive of a change from current conditions.)

The public and secure web applications will be accessible through standard web browsers. The secure web application will provide access to current drought monitoring data and other information used in assessing current drought conditions and is not intended for public use. It will present more complex data using a sophisticated interface to support water resource managers, researchers and decision-makers. Intended users of this site include members of the Drought Task Force and participating water suppliers. The application will include text descriptions, charts, graphs, and maps describing relevant environmental conditions used to determine drought status. Data used by this application will be delivered by ArcIMS and stored in a RDBMS. The application may contain several other standard web application components such as HTML pages, images, JavaScript files, etc. The web applications will be maintained by URI-GEO and URI-NRS.

The notification system software component, to be built by ESRI has three primary functions: 1) the system continually analyzes water-monitoring data in the spatial database against drought severity indices to determine if a significant change in drought status has occurred. If a significant change has occurred, then; 2) The system will automatically alert members of the Drought Task Force via email, phone or fax. Web pages in the Secure Web Application will also be updated to reflect this potential change in drought conditions. If a significant change has occurred, designated individuals can use the Drought Status Update Application to update drought status for watershed, and water district polygons in the spatial data. 3) After completing these changes, the Drought Status Update Application instructs the notification system to notify people on the contact List (i.e., water suppliers, major users, the Governor, etc.) that a change has occurred. WRB will maintain the contact database in MS Access.

The “Drought Status Update Application”, to be built by ESRI, will update the drought status of watershed areas and water supply districts (i.e., change the attribute data of polygons in the spatial database). This will take place after the Drought Task Force has analyzed water-monitoring data using the secure web browser and determined that a significant change in drought condition has occurred. Drought status updates will immediately be reflected in the public and secure web applications. After a change has been made, the Drought Status Update Application will instruct the notification system to alert people on the contact list. Members of

the Drought Task Force will be automatically notified when the notification system detects a significant change in drought conditions (through processing of the monitoring data against indices in the spatial database). Members will determine which drought alert message to send via the DAN and will issue an alert within 24 to 96 hours. The DAN will automatically alert the Drought Task Force on a regular basis if current conditions remain unchanged.

EXPECTED RESULTS OR BENEFITS

The proposed project would complement drought related planning efforts, water management projects and land use planning on a local and statewide basis. Current trends indicate that within the next one or two years, a mild to moderate drought could occur that would affect agriculture and certain water suppliers, and for which degrees of voluntary conservation would be appropriate. Drought management guidelines and a long range plan developed by the Drought Task Force will identify roles for each participating agency, since an important facet of managing drought is simply understanding who is responsible for various measures. The proposed project will increase awareness regarding water availability, demand, and response of the state's groundwater and surface water resources to drought while making data available to local stakeholders. The DAN will provide a test case for future projects both within and outside the metro area, particularly since real-time data monitoring, capacity building and technology transfer are commonly identified as primary objectives in local watershed action plans. Goal oriented language evident in draft water management plans include: increasing understanding of the watershed's hydrological resources and limits, increasing real-time monitoring of stream or groundwater levels, increasing public awareness of the complexity of water allocation issues, and increasing data availability to towns, water suppliers, major water users, and other stakeholders for decision making. Since the DAN is expected to respond to each of those objectives, the Project Team is confident that benefits will be transferable to other watershed groups and land use planners in the state.

Public education and awareness are crucial aspects of drought management. The DAN offers built-in functionality to "mainstream" water information to the public. Sometimes, random drought messages through the news media can cause alarm regarding the integrity of supply or the safety of drinking water. A concerted education and outreach program is essential to provide information when wells go dry, or to inform the public and major users of ways to conserve or find alternate sources of water. The web component of the DAN will be designed to provide meaningful information to a wide range of constituents, including students. Educational programs will be integrated into the URI-NRS run Home*A*Syst Program. Community workshops will focus on methods of protecting indoor and outdoor drinking water supplies and build awareness regarding practices that waste and/or conserve water. URI-NRS will integrate water conservation into its' quarterly newsletter and as educational displays at community events and in local libraries. URI-NRS will develop a web-based evaluation for users to fill out to determine system use and changes in attitudes and behaviors based on information received from the web page.

The Project Team will also provide water suppliers with alert messages and corresponding conservation practices that could be included in bills or as part of other forms of notification, such as public service announcements. The Drought Task Force will generate press releases and display large-scale GIS maps of the state depicting areas in drought. Project Team members and members of the Drought Task Force will maximize interaction with stakeholder groups including the RIWWA, RI Growth Planning Council, RI Watershed Approach Coordinating Council and

local watershed associations, all which meet regularly and frequently. The drought alert messages continually dramatized on television and in the newspaper will be pervasive.

In addition, there is need for high profile, proactive public outreach and education measures. ESRI is experienced with such measures through its many marketing campaigns including direct mail, newsletters and its highly successful GIS Day celebrations. ESRI offers a network of skilled GIS trainers who would be able to assist URI-NRS, EPA and WRB in conducting workshops promoting the use of the DAN in particular and GIS in general. Several water suppliers and their consultants have already exhibited an interest in attending a workshop. EPA-New England will be working with the Project Team to educate citizens and children regarding the watershed approach to water resource management, water conservation and best management practices. An effort will be made to distribute relevant educational materials to RI K-12 schools.

Project Team: Key Partners

USEPA – New England – Planning, management and evaluation aspects of the grant administration will be coordinated by USEPA-New England. Emanuel Souza, Jr., an environmental engineer who been with EPA for eleven years, will be the main point of contact for this project supported by other technical staff in EPA's regional office. In addition to managing the overall budget, Mr. Souza will be responsible for ascertaining that the milestones for the project are met and will submit quarterly reports and/or other documentation as required. He will ensure the use of EMPACT required data and quality assurance standards along with the project team. Additionally, EPA-New England along with the project team will participate in the development of a standard EMPACT Program Technology Transfer Handbook.

WRB - WRB is an agency charged with managing the proper development, utilization and conservation of water resources. Its primary responsibility is to ensure that sufficient water supply is available for present and future generations, apportioning to all areas of the state. WRB has broad authority in planning, developing, and managing water supply. The will be responsible for knowledge management and technology transfer at the state and local level. With EPA, WRB will prepare teaming agreements with each of the funded partners once work scopes and budgets have been refined. Connie McGreavy of WRB will serve as the local team leader and as the primary liaison to EPA-New England. Ms. McGreavy is an environmental scientist with Master's Degree in Public Administration. WRB will hire a technical assistant to assist in all aspects of local project support.

ESRI - ESRI provides consulting, implementation, and technical support services. ESRI is a financially secure, privately held company with annual revenues in excess of $300,000,000. ESRI staff will provide technical support regarding design, development and testing of all facets of the DAN. ESRI will construct an ArcIMS web application to bring real-time drought information into the EMPACT web site.

URI-GEO and URI-NRS - URI-GEO scientists led by Dr. Thomas Boving will collect, store and maintain water data. URI-GEO personnel will oversee data collection and transmission from selected water monitoring locations and assist in the design, development and implementation of the RDBMS required to store and manipulate the data. As a member or the Drought Task Force, Dr. Boving is involved in assessing the severity of drought and advising all partners and stakeholders on appropriate drought responses. URI-NRS will design, develop, implement, and maintain a World Wide Web interface for the public access component of the DAN. The system will be run on a web server at EDC and beta-tested using data generated from public water suppliers. In coordination with EPA-New England, the public outreach, education and training component will be designed by URI-NRS personnel.

Drought Management Task Force - A primary function of this ad hoc task force will be to devise drought indicators, messages and conservation strategies and make recommendations to the Project Team regarding the frequency, target audience and content of drought alerts. The task force will also perform a liaison function to special water related constituencies such as watershed organizations, farmers and public water suppliers. The task force is currently comprised of over 60 people, scientists, educators and other experts, representing a comprehensive cross-section of potential end users, including officials from federal and state agencies, local entities and professional organizations that have responsibility for areas likely to be affected by drought. The task force would handle data interpretation, intergovernmental coordination of drought response actions, and development of a tiered communications strategy to constituencies receiving direct messaging via the DAN. They will package generic media briefings, standard reports and alert messages, and coordinate functions required to ensure timely flow of information to decision makers through the DAN. The work of the task force will complement collaborating agencies while facilitating the activities of the Project Team.

RIWWA and member water suppliers - The RIWWA is the water supply community's industry association. Its president is a participant on the drought management task force and director of a municipal water department outside the metro area. The RIWWA will support project efforts in several ways including publishing project updates in its quarterly newsletter. Together with WRB, RI Department of Health, and PWSB, RIWWA will purchase radio time this summer to deliver daily conservation messages during the morning commute. Currently, information from water suppliers is primarily available in Water Supply System Management Plans submitted to WRB once every five years with an update after 2.5 years. The water supply community is a key link in the project management chain since statutorily, there are no mandates to report at greater frequencies and/or cooperate to the degree that the DAN requires. Because the suppliers are the primary providers of data for the pilot, and because drought triggers vary so dramatically between water districts, it is essential that lines of communication are open.

Federal Partners - USGS has maintained a formal partnership with the WRB and DEM over the years, sharing costs for long-term hydrologic investigations including the installation of stream gauges and observation wells. USGS is planning to upgrade certain water monitoring stations in the metro area to increase real time data collection and transmission capability. In addition, the USGS has pledged to provide technical assistance to the extent possible, ranging from field training to integration of data systems. USGS is currently piloting a water supply/use database called the New England Water Use Data System (NEWUDS). By agreement, USGS will enter data into NEWUDS from watershed investigations and from existing WSSMPs that will be used to augment real time EMPACT project data. NOAA/NWS is a federal partner in regional resource protection initiatives. NOAA has been party to an innovative marine data-monitoring project in partnership with DEM and URI. NOAA/NWS will provide access to precipitation data.

The Mass Media - The list of unfunded partners includes the state's largest newspaper, the Providence Journal Co. (ProJo), along with each of the major television stations. ProJo strives to report on water restrictions imposed throughout the state and clearly considers drought events "news". The managing editor has indicated willingness to publish drought alerts in the form of news stories, maps and/or lists of drought effects by region. Depending on how dynamic the map becomes, placement would be either on the daily weather page or on the front page of the RI section. Reportedly, the extent of drought related mapping by the weather departments of each of the major TV stations corresponds with but a single index now—the Palmer soil moisture index. Predicated on rainfall, this drought threshold is easily reached across the state and is arguably limited as a meaningful indicator. Weathermen believe their news segments would be improved

if they could receive regular drought alert messages with color-coded maps. Attention to data transfer format would be critical since both the newspaper and television companies utilize sophisticated graphics programs. ESRI has established a relationship with the Associated Press via an ArcIMS-based product called MapShop. AP subscribers perform spatial analyses and generate output in a format suitable to their production needs. The project team will work with the local media to explore the use of MapShop in tandem with the DAN. With the frequency of television weather news, the drought alerts would reach a broad segment of the population.

Timeline

August – September 2001
Refine work scope and budgets with stakeholder input, demonstrate SCADA and USGS data systems, experiment with data retrieval and transmission, prepare design template for EMPACT web site and initiate system and application design.

October – December 2002
Hold project team meeting, identify materials/data to be included in the web site, refine data collection schedule, install ESRI software/train partners in software, data collection and transmission methods, review web site design and inventory links, begin building the data converter and notification components, demonstration of IT systems used by mass media partners. Build contact database/identify constituencies to receive alerts, test ArcIMS, begin building the Drought Status Update Application component

January 2002 – May 2002
Continue monitoring activities and testing of systems, prototype drought alert messages and/or maps, issue status reports to EPA and attend regional EMPACT meeting. Conduct bimonthly Project Team meetings, build Secure Web Application and Public Web Application

June 2002 - July 2002
Purchase new equipment and/or technology as recommended, review data and educational components of web sites, documentation delivery and additional training, layout activities, timeline and milestones for following year, hold public workshop on DAN, issue report to media and stakeholder groups and plan program evaluation methods

June 2003
Issue final report

Project Evaluation
The best way to evaluate the DAN is to measure outcomes, the most important of which will be a vastly more informed citizenry that will ideally respond to the drought alert messages and implement voluntary conservation measures upon notification. This decision support system is expected to yield a high return on investment at many levels, including planning, engineering, capital improvements, public safety and sustainable economic development, (though this type of benchmarking would more logically be part of subsequent phases of the initiative). Led by EPA and the Project Team to gauge progress toward objectives, a number of interim measures will be considered including:

- Change in the # of emergency permits sought in metro area for well or pond construction
- Forestalled disaster declarations as evidenced by a decrease in emergency aid sought
- Evidence of decreases in consumption or other conservation action as a result of the DAN
- Number of water suppliers that agree to contribute digital data in addition to project partners

- Amount and type of new data offered by others who support the initiative
- Number of new contacts wishing to subscribe to the DAN
- Number of calls to the hotline, visits to the website(s) and/or emails received
- Amount and quality of feedback from database users, DAN alert recipients and the media
- Number of people who indicate a willingness to attend education or training forums
- Number of formal data requests to conduct water-related research using the DAN
- Amount of money and in-kind support invested and pledged by stakeholders
- Amount of publicity the DAN gets, particularly from out of state or unaffiliated parties

The DAN will also serve as a prime resource for many local groups that need, but cannot independently afford a sophisticated and comprehensive data system. Internet-based data will lessen some communities' and nonprofit organizations' reliance on expensive consultants and eliminate or delay the need to upgrade information systems. The degree to which end users will access the drought information is measurable, and will provide some understanding of project "reach". A concerted effort will be made to devise a "feedback loop" to assess the efficacy of various methods of notification, which alerts result in the greatest water reductions, and which regions were most affected. Also, because the work plan provides for built in liaison between many partners and stakeholders, the degree to which the DAN serves as a useful tool for community-based decision making will become apparent through normal programmatic and outreach communication channels. Rhode Island is a small state, and thus serves, as an excellent pilot. Experience gained could be readily transferred to other states, particularly those in the New England region that share a similar approach to drought management.

In conclusion, a National Drought Policy Commission established by Congress in 1998 to provide advice and recommendations on the creation of an integrated, coordinated Federal policy designed to prepare for and respond to serious drought emergencies, issued a report in May 2000 of their recommendations[1]. The Commission believes that national drought policy should use the resources of the federal government to support but not supplant nor interfere with state, tribal, regional, local and individual efforts to reduce drought impacts. The Commission issued five goals of national drought policy council: 1) Incorporate planning, implementation of plans and proactive mitigation measures, risk management, resource stewardship, environmental considerations, and public education as the key elements of an effective national drought policy; 2) Improve collaboration among scientists and managers to enhance the effectiveness of observation networks, monitoring, prediction, information delivery, and applied research and to foster public understanding of and preparedness for drought; 3) Develop and incorporate comprehensive insurance and financial strategies into drought preparedness plans; 4) Maintain a safety net of emergency relief that emphasizes sound stewardship of natural resources and self-help; and 5) Coordinate drought programs and response effectively, efficiently, and in a customer-oriented manner. This EMPACT proposal meets three of the Commission's goals.

[1] Report of the National Drought Policy Commission: Preparing for Drought in the 21st Century, May 2000

BUDGET

BUDGET JUSTIFICATION

The innovative nature of this project does not allow for complete accuracy in making information technology budget projections, since the "no hands" drought alert delivery system proposed is a first-time application. Members of the Project Team have had candid discussions with ESRI application developers regarding the business practicality of developing the technological solutions sought. Funds of $100,000 have been estimated for systems development regarding the innovative information technology component. Federal partners are expected to share technology at no cost to the Project Team. WRB has earmarked funds in the Fiscal Year 2002-2003 operating budget to pay for information systems evaluation and local administration. WRB will obligate 20% of the Connie McGreavy's salary and fringe benefits toward the cost share. Orderly administration of the local support will require a part-time Technical Assistant to local project manager for the two-year period. Ideally, this individual would be knowledgeable in MIS and skilled in GIS. WRB will obligate the remaining cost share toward charges incurred by the Rhode Island Department of Administration for technical consulting.

Contractual costs represent best estimates provided by project partners. If the project is funded, each partner would be requested to submit a final work scope clarifying all tasks, responsibilities and acceptable costs. The Rhode Island Department of Administration will oversee the purchase of all information technology equipment for WRB, including computer hardware, software and a GPS unit. URI-NRS owns a license for ESRI's ArcIMS software valued at $7500 as well as hardware valued at approximately $9000. Other software licensing anticipated includes ESRI ArcSDE and/or ORACLE. URI-NRS will designate approximately 4% of salaries for two Principal Investigators who will not receive any funds from this grant; URI-GEO will designate approximately 5% of salaries for Dr. Boving. ESRI will donate approximately $7500 worth of in-kind services and educational materials for the purposes of public relations. It is notable that this application would not be possible had URI not slashed its 25% Indirect Costs down to 12.2%. Total cost share is reflected in the budget and the Actual Program Cost in the Abstract.

EPA-New England would receive and administer grant and/or contract funds on behalf of key partners. EPA assumes no liability for payment of services prior to receipt of funds and services will not be pre-paid. Local water suppliers that opt to participate in the DAN will provide access to data at no additional cost. Encouraging or assisting in technology transfer within the water supply community enhances local capacity building while grant objectives are accomplished. Major media private sector partners such as the Providence Journal Co. and each of the major television networks will be interfacing with the Project Team with an eye toward final execution of information delivery to the general public. These groups see this initiative as a way to improve internal capacity to deliver news in a timely and effective manner; they will likely provide in-kind resources toward technology transfer. The Project Team will seek additional funding and cooperation among partners to expand the project throughout the metro area and then statewide, depending on success of the pilot.

Like EPA, some Rhode Islanders have begun to press for formal data sharing agreements among partners, and advocate for greater, sustained and/or leveraged investment in information technology as an environmental protection tool. However, to be successful, there must be a change in the "culture" that causes organizations and individuals to view information as a resource to be shared and used strategically. Moreover, there must be a mechanism to create a dedicated funding stream. Without these things, innovative proposals like this one proceed under-budgeted, under-managed, behind schedule and become a source of frustration to both program managers and secondary users. The Project Team will research ways to identify patterns of overlapping investments that would support pooled investments and partnerships. The DAN is the impetus for coordination at the local level.

Toward that end, the Governor of RI has proposed establishment of an annual RI e-Government Fund with an initial appropriation of $8,400,000 in Fiscal Year 2002. This fund could be a vehicle through which project partners could formally collaborate regarding joint MIS in the future. In out-years, the proposal provides a certain percentage of state revenue from 0.2% to 0.4% for e-government. The Governor's Growth Planning Council and the RI Watershed Approach Coordinating Council have both named GIS as an important tool for land and resource planning and are advocating for increased investment in the FY2002 state budget. These entities are focused on building capacity at the local level, coordinating/leveraging funding opportunities and strengthening internal/eternal communication. Rhode Island is a small state, and these actions all work to enhance prospects for successful and sustained implementation of the DAN.

Additionally, the WRB is leveraging $100,000 of federal funds shared by the RI Dept. of Transportation for revising the public water supply districts and water transmission lines in RIGIS layers that have not been updated for ten years. The agency is also working with telecommunications firms to lay cable in road rights-of-way for public data access across the state. RI E-911 is working with RIGIS to spatially reference emergency features such as street centerlines, hydrants, fire ponds, etc. The RI Dept. of Environmental Management is currently providing staff for mapping of watershed lands purchased by water suppliers. The agency is also hosting water supply data in an Intranet application to which the WRB web page is linked. Additionally, the WRB is working in partnership with USGS to prototype the NEWUDS database. Other water-related data sharing initiatives are under development. In terms of project coordination and efficiency, the direction and timing of each will dovetail nicely with EMPACT.

Preliminary grant research indicates that this project may be eligible for an Innovations in Government Grant in the range of $100,000. Money from this program is awarded "after-the-fact", that is, after the Project Team demonstrates success.

PRELIMINARY BUDGET for EMPACT PROJECT Drought Alert Network			
Categories	**Year One**	**Year Two**	**Project Total**
Personnel Costs			
Sub-Total	$0.00	$0.00	$0.00
Travel Costs			
In-state			
Out-of-state			
EMPACT meeings-2			
Sub-Total	$0.00	$0.00	$0.00
Equipment			
Sub-Total	$0.00	$0.00	$0.00
Supply Costs			
Sub-Total	$0.00	$0.00	$0.00
Contractual Costs			
WRB	$28,400.00	$27,200.00	$55,600.00
ESRI	$100,000.00	$0.00	$100,000.00
URI/NRS-EDC	$28,218.00	$28,218.00	$56,436.00
URI/NRS-CE	$61,642.68	$74,994.48	$136,637.16
URI-GEO	$39,135.00	$12,184.00	$51,319.00
Sub-Total	$257,395.68	$142,596.48	$399,992.16
Total Costs	**$257,395.68**	**$142,596.48**	**$399,992.16**
Cost share	$20,506.00	$25,269.00	$45,775.00
Total with Cost Share Added	$277,901.68	$167,865.48	$445,767.16

PRELIMINARY BUDGET for EMPACT PROJECT WRB Drought Alert Network			
Categories	**Year One**	**Year Two**	**Project Total**
Personnel Costs			
Technical Assistant	$20,000.00	$20,000.00	$40,000.00
Fringe Benefits	$0.00	$0.00	$0.00
Sub-Total	$20,000.00	$20,000.00	$40,000.00
Travel Costs			
In-state	$300.00	$300.00	$600.00
Out-of-state	$400.00	$400.00	$800.00
EMPACT meeings-2	$2,000.00	$2,000.00	$4,000.00
Sub-Total	$2,700.00	$2,700.00	$5,400.00
Equipment			
GPS Unit	$1,200.00	$0.00	$1,200.00
Server Upgrade	$3,500.00	$3,500.00	$7,000.00
Sub-Total	$4,700.00	$3,500.00	$8,200.00
Supply Costs			
Printing	$500.00	$500.00	$1,000.00
Misc.	$500.00	$500.00	$1,000.00
Sub-Total	$1,000.00	$1,000.00	$2,000.00
Contractual Costs			
Sub-Total	$0.00	$0.00	$0.00
Total Costs	**$28,400.00**	**$27,200.00**	**$55,600.00**
Cost share	$20,506.00	$25,269.00	$45,775.00
Total with Cost Share Added	$48,906.00	$52,469.00	$101,375.00

COST SHARE BUDGET for EMPACT PROJECT Drought Alert Network			
Categories	**Year One**	**Year Two**	**Project Total**
Personnel Costs			
Sub-Total	$0.00	$0.00	$0.00
Travel Costs			
Sub-Total	$0.00	$0.00	$0.00
Equipment			
Sub-Total	$0.00	$0.00	$0.00
Supply Costs			
Sub-Total	$0.00	$0.00	$0.00
Contractual Costs			
WRB	$10,010.00	$10,010.00	$20,020.00
ESRI	$1,500.00	$6,000.00	$7,500.00
URI/NRS-EDC	$0.00	$0.00	$0.00
URI/NRS-CE			
URI-GEO	$7,496.00	$7,759.00	$15,255.00
OLIS (WRB)	$1,500.00	$1,500.00	$3,000.00
Sub-Total	$20,506.00	$25,269.00	$45,775.00
Total Costs	**$20,506.00**	**$25,269.00**	**$45,775.00**

Cost Estimate for EPA "EMPACT" Grant URI-GEO	EMPACT		
Duration of the project: 2 years	**Year 1**	**Year 2**	**Total**
(November '01 through October '03)			
Item	**Cost**	**Cost**	
Salaries			
Dr. T. Boving, (1 mos summer)	$2,753	$5,700	$8,453
1 Grad Res Ass't at 100% AY	$10,707		
1 Grad Res Ass't 100% summer	$7,000		
1 Undergrad Student, AY (hourly @ $7.70/hr)		$2,813	$2,813
1 Undergrad Student, summer (hourly @ $7.70/hr)		$1,250	$1,250
Subtotal, salaries	**$20,460**	**$9,763**	**$30,223**
Fringe Benefits			
Grad Res Ass't summer @ 7.65%	$536		$536
Undergrad Ass't summer @ 7.65%		$96	$96
Dr. T. Boving (41% on matched salary)			$-
Subtotal, Fringe Benefits	**$536**	**$96**	**$631**
Supplies			
Data storage (CDs, ZIPs, etc.)	$500	$500	$1,000
Pproject dedicated computer with MS Professional Office software	$3,200		$3,200
Subtotal, Supplies	**$3,700**	**$500**	**$4,200**
Travel			
Meetings with data providers and our-of-state travel	$600	$500	$1,100
Subtotal, Travel	**$600**	**$500**	**$1,100**
Other Direct Costs			
Tuition, 1 Grad Res Ass't, AY	$10,754		$10,754
Subtotal, Other Direct Costs	**$10,754**	**$-**	**$10,754**
Total Direct Costs	**$36,049**	**$10,859**	**$46,908**
Indirect Costs (F&A) @12.2% MTDC (total costs minus tuition)	**$3,086**	**$1,325**	**$4,411**
TOTAL COST (one year)	**$39,135**	**$12,184**	**$51,319**

Cost Estimate for EPA "EMPACT" Grant URI-EDC Duration of the project: 2 years	Year 1 Cost	Year 2 Cost	Total
Salaries			
Research Associate (0.3 FTE)	13,500	13,500	
Subtotal, salaries	**13,500**	**13,500**	
Fringe Benefits			
Research Associate	4,050	4,050	
Subtotal, Fringe Benefits	**4,050**	**4,050**	
Operational cost			
ADP Charges	7,200	7,200	
Subtotal, Operational Cost	**7,200**	**7,200**	
Travel	**400**	**400**	
Equipment			
Other Direct Costs			
Subtotal, Other Direct Costs			
Total Direct Costs	**25,150**	**25,150**	
Indirect Costs (F&A) @ 12.2% MTDC	**3,068**	**3,068**	
TOTAL COST (one year)	**28,218**	**28,218**	
TOTAL COST (two years)			**56,437**

COST ESTIMATE for EMPACT PROJECT ESRI Drought Alert Network			
Categories	**Year One**	**Year Two**	**Project Total**
Personnel Costs			
Application Developer	$54,600.00	$35,600.00	$90,200.00
Account Manager (PR, outreach)	$2,400.00	$2,400.00	$4,800.00
Sub-Total	$57,000.00	$38,000.00	$95,000.00
Travel Costs			
	$3,000.00	$2,000.00	$5,000.00
Sub-Total	$3,000.00	$2,000.00	$5,000.00
Equipment			
Sub-Total	$0.00	$0.00	$0.00
Supply Costs			
Sub-Total	$0.00	$0.00	$0.00
Contractual Costs			
Sub-Total	$0.00	$0.00	$0.00
Total Costs	**$60,000.00**	**$40,000.00**	**$100,000.00**

EMPACT Drought Alert Network Project

Budget for URI/NRS-CE Outreach Component

Categories	Yr One (9 months)	Year Two (12 months)	Total Project (21 months)
a. Personnel Costs			
Res. Assoc (Web Interface)	$16,500.00 (36% of ann. Sal.)	$22,000.00 (48% of ann. Sal)	$38,500.00
Res. Assoc (Training and Educ.)	$16,500.00 (36% of ann. Sal)	$22,000.00 (48% of ann. Sal)	$38,500.00
Student Interns	$2,000.00 (2*12 hrs/wk)	$2,000.00 (2* 15 hrs/wk)	$4,000.00
Total Personnel Costs	$35,000.00	$46,000.00	$81,000.00
b. Fringe Benefits (36% of Res. Assoc. salary)	$15,840.00	$15,840.00	$31,680.00
Total Benefits	$15,840.00	$15,840.00	$31,680.00
c. Travel			
Providence meetings (15 trips/yr)	$300.00	$300.00	$600.00
Training and Coord. (15 trips/yr)	$300.00	$300.00	$600.00
Total Travel	$600.00	$600.00	$1,200.00
d. Equipment	$-	$-	$-
e. Supplies	$800.00	$800.00	$1,600.00
Computer Charges (software, system support, backup)	$2,700.00	$3,600.00	$6,300.00
e. Total Supplies	$3,500.00	$4,400.00	$7,900.00
f. Total Direct Costs	$54,940.00	$66,840.00	$121,780.00
f. Indirect Costs (12.2% of direct costs)	$6,702.68	$8,154.48	$14,857.16
Total URI/NRS-CE	$61,642.68	$74,994.48	$136,637.16

QUALITY ASSURANCE STATEMENT

QUALITY ASSURANCE STATEMENT

Certain members of the Project Management Team—most notably USGS partners—have familiarity with the requirements of ANSI/ASQC E4, "*Specifications and Guidelines for Quality Systems for Environmental Data Collection and Environmental Technology Programs"*. Relevant portions of R-5 "*EPA Requirements for Quality Assurance Project Plans"* and G-4, "*Guidance for the Data Quality Objectives Process*" will be disseminated to all members of the Project Team, water supply monitors working for, or on behalf of municipal water supply systems, and information technology experts charged with designing quality assurance checks within software applications and the data collection/storage system.

The interdisciplinary team assembled will provide expert oversight, training and peer review regarding various matters. In the recent past, federal partners have reportedly increased their monitoring activities to ensure that the data provided is credible. For example, extra field measurements to verify stream flow data and/or collect groundwater data were taken last year. The USGS is compiling additional data on the extent and affects of the 1999 drought on water resources in the eastern US and plans to release a formal report this year. This data—which is retrievable—will provide a foundation for study of drought and its human impacts and lead to better approaches for managing drought. The vision for the EMPACT grant establishes the need to expand data collection for purposes of validating drought alert requirements.

In any case, the USGS, NOAA/NWS, and public water suppliers are responsible for operating and maintaining water-monitoring equipment according to manufacturer's instructions. Water levels and other measurements performed by the USGS are collected and computed using rigorous and established methods and procedures of the Massachusetts-Rhode Island Division as set forth in US Geological Survey Techniques of Water-Resources Investigations, technical memorandums, Water Supply Paper WSP-2175, and Area Quality Assurance Plans. Similar quality assurance parameters are in place for data provided by NOAA/NWS, practices which can be transferred to water suppliers that are automating data collection. The quality of data collected by Bristol County Water Authority and North Kingstown Water Department will be insured by standard operation procedures and quality assurance plans that will be prepared as part of the monitoring effort. Field measurements will be taken by trained and qualified persons, using only calibrated and fully tested equipment. Errors that occur during data transfer from field report sheets into the computer will be tracked down using archived field reports.

All errors will be investigated and only validated data will be allowed into information systems. Draft documents or provisional data will be clearly identified and limitations of data will be noted. Appropriate security measures will be taken to protect the integrity of the data systems. (Separate web servers and redundant databases are anticipated.) Metadata that is in compliance with federal GIS standards will be developed. Data collection methodologies, both in the field and in terms of the data collection/storage/manipulation/interpretation of data will be documented to the extent practicable. This oversight will ensure the integrity of the data collected and viability of the monitoring approach from a quality assurance/quality control standpoint.